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ABSTRACT

A study examined the relationship between investment in training and labor productivity in a sample of 237 large and medium-size Taiwanese firms producing auto parts. Of the 162 firms (68.4%) that returned usable questionnaires, 142 (59.9%) had training programs and 131 (55.3%) provided full cost data. The data were analyzed by multiple regression to determine the relationship between investment in training and labor productivity at the firm level while controlling for other variables affecting labor productivity. In U.S. dollars, the 131 firms' total training costs in 1992 averaged $79,784 ($31,847 in direct costs and $47,937 in opportunity costs). The number of workers per firm averaged 285, and the firms' per-worker training investment and direct training costs averaged $280 and $112, respectively. The average yearly sales per worker for all the firms reporting training was $91,280. A multiple regression analysis established that, if an average firm had a current value added per worker of approximately $43,040 and an average investment in total training cost per worker of $280, increasing the investment in training per worker by 10% ($28) could yield an increase in value added per worker of $430, provided the increase could occur without any need for compensatory investments in capital or other additional resources. (Contains 18 references.) (MN)

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"An Organization's Economic Return on Training Investment"

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The Problem

The impact of training on the productivity of an organization has often been assumed but has rarely been studied. A major reason is that most trainers focus their evaluations on the extent to which training has impacted the individuals trained. They have focused on Kirkpatrick's (1967, 1978) four levels of evaluation: 1) trainee reaction to training, 2) trainee accomplishment of learning outcomes, 3) trainee behavioral changes on the job, and 4) the results of trainee change in behavior. They then assume if training improves the performance of individuals it will improve the performance of the organization.

In contrast to a focus on individuals, top level managers responsible for allocating resources within an organization tend to focus their attention on the overall performance of the organization. Studies conducted with non-training managers have revealed that they believe the impact of training should be judged using the organization as the unit of analysis and not individuals (Carnevale & Schulz, 1990; Kusy, 1988). Given the discrepancy between the types of information typically gathered and used for decision making by trainers and that desired by other managers, it is not surprising that training budgets are often easy targets for corporate cost-cutting (Geber, 1991; Kaney, 1991; Lee, 1992). Data showing results of training which focus on gain to individuals are often not compelling in arguing for resource allocations at the organization level. If investments in training are to receive higher priority, top management must clearly see an economic relationship between their investments in training and increased organizational productivity (Bartel, 1989, 1991; Carnevale & Schulz, 1990; Lyau, 1994).

Purpose and Conceptual Framework

This study I will be reporting on today was designed to investigate the extent to which an investment in training is related to increased labor productivity in a manufacturing industry. Productivity was viewed as the relationship between resource inputs and production outputs. Traditionally, resource inputs to production have been defined as capital, labor, and material (Ehrenberg & Smith, 1988). This study tested the belief that an investment in human capital through training would increase workers' future productivity beyond that attributable to capital, labor and material.

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The study was framed within two basic assumptions underlying human capital theory posed by Becker (1975). First, training involves costs. Those costs not only include direct costs (e.g., materials and equipment used during training), but also indirect or opportunity costs such as the monetary value of lost production while trainers and trainees are involved in training. Opportunity costs have been found to often exceed a firm's direct out-of-pocket costs for training (Tan, 1989; Vaughan & Berryman, 1989).

The second assumption was that training which results in workers acquiring new knowledge, skills, and attitudes, will increase workers' future productivity beyond the costs of training. This assumption is similar to assuming an investment in physical capital such as machinery will yield a return greater than the cost of the physical capital.

Given these assumptions, it seems reasonable that management will invest in training if future productivity increases are expected to exceed the total costs of training. This study was designed to investigate if increased investments in training will yield labor productivity returns larger than the costs of training while controlling for other forms of inputs which might affect productivity.

Methods

A sample of 237 large and medium size Taiwan firms which produce auto parts was selected for the study. The auto parts manufacturing industry in Taiwan was selected because of its importance in Taiwan's economy and because it provided a setting where uniform data could be collected over a large number of firms within a given manufacturing industry. Information available included not only information on investment in training but information on organizational productivity and other investments such as capital, labor and materials which might also affect the labor productivity of organizations.

Data were gathered with an instrument developed by Lyau (1994), and entitled "Survey Questionnaire for the Study of Effects of Employer-Sponsored Training on Labor Productivity in the Auto Parts Industry in Taiwan." The questionnaire gathered data in three areas: a) firm background and human resources-related policies, b) financial data, and c) training activities. The operational definition of training used followed the definitions of Taiwan's Bureau of Employment and Training. It includes the full range of employer-sponsored training activities provided to all levels of employees including managers, professionals, engineers, technicians, skilled and clerical workers that are related to increasing a firm's production with the exclusion of diploma-oriented school-based vocational training. The definition excluded activities not considered to be related to production such as new employee orientation, fire safety training, foreign language training, etc. The questionnaire was validated in Taiwan by a panel of experts.

Data were gathered for the 1992 fiscal year through a mailed questionnaire. Of the 237 firms originally selected, 162 (68.4%) returned usable data. One hundred and forty-two (59.9%) had training programs and 131 (55.3%) provided full cost data.

Data were analyzed using multiple regression with the intent of examining the relationship between investment in training and labor productivity at the firm level while controlling for other variables that might affect labor productivity. Bartel's (1989) econometric model was modified and served as a basis for deriving the regression models used in this study. Data from the survey were organized into four categories (See Table 1).

Table 1

Study Variables

Dependent Variables

1. Sales per worker (total sales/number of workers)
2. Value-added (sales minus materials) per worker

Independent Variables

a. Investment in training

1. Direct costs of delivering training provided by the firm (does not include trainer salaries)
2. Total costs of training (direct costs & indirect costs including trainer and trainee salaries during training)

b. Traditional input variables

1. Fixed capital costs (excluding land)
2. Material costs
3. Labor (number of employees)

c. Additional control variables:

1. Firm's staffing effort (number of approaches used to recruit new employees)
2. Average years of schooling of employees
3. Square of average years of schooling
4. Average years of job tenure of employees in the firm
5. Square of job tenure
6. Unionization (union vs non-union)
7. Age of the firm (years)
8. Profit-sharing (had a plan vs did not)
9. Employee stock ownership (had a plan vs did not)
10. R & D (had R&D expenditures vs did not)
11. Exported goods (had exported vs did not)

The first category includes the measures of a firm's labor productivity (dependent variables). They were sales per worker and value-added per worker. Sales per worker was calculated by taking the total dollar value of a company's sales and dividing it by the number of workers. Value-added per worker was calculated by first subtracting the cost of materials in

the products sold from the total sales and then dividing by the number of workers. The difference between the cost of materials and what the products produced from those materials were sold for was considered value added.

The next three categories contain independent variables which might account for variations in a firm's labor productivity. The first category of independent variables includes two ways of measuring a firms investment in training: direct cost of training and total costs of training including direct and indirect costs. Only one of these was included in each analysis. The second category of independent variables includes the traditional input variables of fixed capital costs, materials costs and labor costs which might be alternative sources of variations in labor productivity. The third contains additional control variables found in the literature that might affect labor productivity other than investment in training and the traditional input variables.

Before conducting the analyses a number of manipulations of the data were required to meet the major assumptions of multiple regression. Both the average years of schooling and average years of job tenure were considered to not be linearly related to labor productivity. Therefore, both the averages and the square of the averages for these two variables were included in the analyses (Ehrenberg & Smith, 1988; Fleisher & Kniesner, 1980; Holzer, 1988; Maranto & Rodgers, 1984).

It was also found that some of the variables were not distributed in a normal bell shaped distribution (sales per worker, value-added per worker, capital, labor, material cost, total training cost, and direct training cost). As a result, the standard deviations of some variables were larger than the means (see Table 2). Therefore, they were transformed into logarithmic form to make them more normally distributed (Zilbert, 1992).

Four multiple regression analyses were used to answer the following four questions. The four questions represent combinations of different ways of measuring investment in training and labor productivity. The goal was to investigate possible relationships between the two ways of measuring investment in training and the two ways of measuring labor productivity.

Question 1: Do firms investing more on employee training (measured by total training costs) have higher labor productivity (measured by sales per worker) than those investing less on training, other variables held constant.

Question 2: Do firms investing more on employee training (measured by direct training costs) have higher labor productivity (measured by sales per worker) than those investing less on training, other variables held constant.

Question 3: Do firms investing more on employee training (measured by total training costs) have higher labor productivity (measured by value-added per worker) than those investing less on training, other variables held constant.

Question 4: Do firms investing more on employee training (measured by direct training costs) have higher labor productivity (measured by value-added per worker) than those investing less on training, other variables held constant.

In those cases where value-added per worker was the measure of labor productivity, cost of materials was eliminated as a control variable because it had already been subtracted out of the measure of labor productivity.

Findings

Tables 2 and 3 contain descriptive data about the variables included in the study. The average total training costs in 1992 for the 131 firms that provided all training cost data was U.S.$79,784. Direct training costs were $31,847 and opportunity costs were $47,937. The average number of workers in the 131 firms was 285. Therefore, the average investments per worker based on total training cost and direct training cost were about U.S.$280 and $112,

Table 2

Descriptive Means and Standard Deviations
for Continuous Variables Used in the Regression Equations

Variables	Mean	Std Dev	N*
Sales per worker	U.S. $91,280	$63,190	140
Value-added per worker	$43,040	$27,820	138
Fixed capital (per firm)	$10,395,600	$19,247,760	137
Material cost (per firm)	$14,171,250	$31,614,060	138
Staffing effort	3.34	1.29	142
Age of firms	18.94	9.97	142
Workers' years of schooling	10.71	1.07	140
Workers' years of job tenure	5.50	3.31	141
Number of workers	285	398	131
Total training cost (per firm)	$79,784	$317,207	131
Total training costs (per worker)	$280	$400	131
Direct training cost (per firm)	$31,847	$97,815	131
Direct training cost (per worker)	$112	$210	131
Indirect (opportunity) cost (per firm)	$47,937	$293,071	131
Indirect (opportunity) cost (per worker)	$168	$320	131

* The number of firms included in each calculation varied depending upon how many provided each type of data.

respectively. The average yearly sales per worker for all firms reporting training was U.S.$91,280.

The pattern of higher indirect training costs ($47,937) than direct training costs ($31,847) was consistent with the literature (Tan, 1989; Vaughan & Berryman, 1989). The data showed that the foregone short term output lost when employees are involved in training was even higher than employers' "out-of-pocket" or direct costs associated with the training.

A majority of the firms were not unionized, exported goods, did not have stock ownership plans, and had profit-sharing plans. About 40% of the firms had no R & D expenditures.

Table 4 presents the results of the multiple regression analyses designed to address each of the study's four primary questions. The partial regression coefficient

Table 3
Numbers and Percents for Dichotomous Variables

Variables	Number of firms	Percent of firms
Unionization		
Firms with unionized workers	44	31.0%
Firms without unionized workers	98	69.0%
R&D		
Firms with R & D expenditure	85	59.9%
Firms without R & D expenditure	57	40.1%
Exports		
Firms exported goods	114	80.3%
Firs not exported goods	28	19.7%
Employee Stock Ownership		
Firms with employee stock ownership plan	10	7.0%
Firms without employee stock ownership plan	132	93.0%
Profit Sharing Bonuses		
Firms with profit-sharing plan	93	65.5%
Firms without profit-sharing plan	49	34.5%

between the dependent variable (labor productivity) and the measure of training investment in each analysis was the statistic of primary interest. Therefore, the partial regression coefficient related to each question is presented as bold numbers. This partial regression coefficient indicates the extent of the relationship between an investment in training and labor productivity while statistically controlling for the impact of the other control variables in the equation.

Table 4

Partial Regression Coefficients Between
the Independent Variables and the Dependent Variable
for Each Study Question

Independent Variables:	Quest. 1	Quest. 2	Quest. 3	Quest. 4
	Dependent Variable			
	sales per worker	sales per worker	value-added per worker	value-added per worker
Total training cost	**.01**	---	**.10***	---
	(.30)	---	**(1.76)**	---
Direct training cost	---	**.03**	---	**.12***
	---	**(.84)**	---	**(2.41)**
Capital	.08*	.06*	.22*	.20*
	(1.73)	(1.21)	(2.77)	(2.62)
Number of employees	-.70*	-.62*	-.38*	-.30*
	(8.76)	(8.21)	(3.21)	(2.73)
Material cost	.52*	.50*	---	---
	(12.26)	(11.56)	---	---
Staffing effort	-.01	-.01	.04	.04
	(.34)	(.40)	(.79)	(.83)
Years of schooling	.57	.63	.57	.75
	(.94)	(1.04)	(.57)	(.75)
Squared years of schooling	-.03	-.03	-.02	-.03
	(.90)	(.99)	(.54)	(.73)
Years of job tenure	-.03	-.04	-.05	-.05
	(.76)	(.90)	(.70)	(.60)
Squared years of tenure	.00	.00	.00	.00
	(1.15)	(1.24)	(.94)	(.84)
Unionization	.05	.04	.05	.04
	(.63)	(.43)	(.34)	(.27)
Age of firm	.00	.00	-.00	-.00
	(.57)	(.41)	(.07)	(.31)

Profit sharing bonus	.10 (1.29)	.07 (.86)	.14 (1.12)	.10 (.84)
Employee stock ownership	-.20 (1.38)	-.21 (1.52)	-.35 (1.50)	-.34 (1.53)
R & D investment	.07 (.91)	.05 (.63)	-.03 (.20)	-.03 (.20)
Exports	.02 (.26)	.05 (.47)	-.17 (1.08)	-.16 (.97)
Constant - intercept term	-.56 (.18)	-.89 (.27)	.20 (.04)	-.80 (.15)
R^2	.65	.61	.21	.19
Adjusted R^2	.60	.57	.11	.10
N	129	134	127	132
F-statistics	13.98*	12.50*	2.13*	2.01*

* significant at the level of .05

Note: Absolute t-statistic values associated with coefficients are in parentheses.

The first two columns in Table 4 present the results relative to questions one and two which used sales per worker as the measure of labor productivity. Both revealed that training investment measured as either total costs or direct costs had very little relationship to labor productivity measured as sales per worker (statistically non-significant). The regression coefficients were only .01 and .03.

However, the results presented in the last two columns of Table 4 relative to questions three and four which used value-added per worker as the measure of labor productivity were significant. When labor productivity was measured as value-added per worker, which removed the cost of materials from the measure of labor productivity, both measures of training investment had strong positive relationships with labor productivity. As investment in training increased, labor productivity increased. The extent of the increase is reflected in the size of the partial coefficients. The partial coefficient between total costs and value-added per worker was .10. The partial coefficient between direct costs and value-added per worker was .12. These results can be interpreted as indicating that if an average firm in the study invested an additional 10 percent of its current training expenditures on training, it might expect an increase in the level of labor productivity by a range of between 1.0 percent and 1.2 percent, with other factors that might affect productivity being held constant. Therefore, if an average firm had a current value-added per worker of about U.S. $43,040 and an average investment in total training cost per worker of $280, as reported in Table 2, increasing the investment in training per worker by 10% (.10 X $280) $28 could yield a

increase in value-added per worker of (.01 X $43,040) $430. This supposes that the increase could occur without the need for compensatory investments in capital or other additional resources.

It is important to note that these significant relationships were found between investment in training and value-added labor productivity while statistically controlling for other variables which the literature suggested might cloud the relationship. This suggests that the relationship tends to be robust. It is present even after removing the influence of many other factors that might affect labor productivity. In addition, study results indicate that there is a positive relationship between investment in training and value-added labor productivity even when the training investment is expanded to include not only direct training cost, but a firm's opportunity cost. This suggests that the relationship between an investment in training and returned productivity is large enough to be able to account for total costs of training.

Conclusions and Implications

It has become increasingly apparent that in order for training to retain or receive larger amounts of organizational resources it must be viewed as a competitor with other types of investments the organization might make to increase productivity. The assumption that trainers have made based on Kirkpatrick's four levels of evaluation that if individuals benefit from and change behavior due to training, organizational productivity will increase, does not appear to provide the type of compelling evidence managers desire. Managers are requiring more direct types of evidence that investments in training will yield higher organizational productivity. They not only want to know if training will increase productivity, but how much productivity will be increased. That information can then be used to determine if they should invest in training versus other investments such as capital or increased numbers of workers (Carnevale & Schulz, 1990; Geber, 1991; Kaney, 1991; Kusy, 1988; Lee, 1992).

This study was designed to investigate the impact of training on the "bottom line" of a company. It was designed to investigate the relationship between investment in training and labor productivity after removing the influence of 14 other variables managers tend to attribute to increases in productivity. This is important because even if a direct relationship can be shown between investment in training and labor productivity, it could be argued that other changes being made in the company at the same time caused the increased productivity and not training.

The study was also designed to analyze investment in training in terms of direct costs and total costs. This was done to remove the possible criticism that although direct cost investments in training may be related to increases in productivity, such costs do not include other costs such as salaries of workers and trainers during training.

Although the study was done in only one industry (auto parts industry in Taiwan), had a limited response rate from companies that provided complete data (55.3%), and had a limited number of subjects in the analyses for the number of variables studied (131 subjects and 15 variables), it provides encouraging results and a methodology for gathering data on the impact training has on the productivity of an organization. Significant relationships were found between investments in training as measured by direct training costs and total training costs; and labor productivity as measured by value-added per worker. These results were

found even after statistically removing the influence of 14 variables the literature suggests could be alternative explanations for increases in the productivity. The results held even when total training costs included salaries of workers and trainers.

The methodology not only allows for a judgement on the strength of the relationship between investment in training and productivity, but it also provides a means of estimating the actual dollar return in labor productivity from an increased investment in training. In practical terms the results showed that a relatively small additional investment in training per worker could bring about relative large returns in productivity within the firms studied. (The detailed sample calculations were presented earlier.) In this study, an additional investment of only $28 in training per worker had the potential of returning $430 in value-added labor productivity per worker assuming other resources such as increased capital expenditures (e.g., equipment) would not be required. However, one must be cautious when making such estimates because it is likely that the amount of return from additional investments in training could taper off at some point.

The results of this study can have a profound influence on the investments made in training in the future. If such results can be duplicated in additional studies using the methodologies described, they can provide evidence to managers that an investment in training can have a direct and sizable effect on the "bottom line" of organizational productivity.

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